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EXAMINER	
TRUONG, CAM Y T	
ART UNIT	PAPER NUMBER
2162	

DATE MAILED: 05/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/092,994	DOUCEUR ET AL.	
	Examiner	Art Unit	
	Cam Y T Truong	2162	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 January 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-48* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

SHAHID ALAM
PRIMARY EXAMINER

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3/24/05, 1/13/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Claims 1-48 are pending in this Office Action.

Applicant's arguments filed January 31, 2005 have been fully considered but they are not persuasive for the following reasons.

Applicant argues on pages 18 – 41 that Duvillier does not teach the homeless object; the combination of Duvillier and Zakai does not teach the claimed limitation receiving an indication of a homeless replica of an object, wherein the object has a plurality of replicas including the homeless replicas; determining an initial placement for the homeless replicas, wherein the initial placement is one of a plurality of devices in a system; evaluating whether any replicas of the object can be swapped with one of a plurality of replicas of another object and not reduce a combined object; and swapping a replicas of the object with the one of the plurality of replicas of the other object only if the swapping does not reduce the combined object availability of the two object; receiving an indication of a homeless replica of an object, wherein the object has a plurality of replicas including the homeless replicas; determining an initial placement for the homeless replicas, wherein the initial placement is one of a plurality of devices in a system; evaluating whether any replicas of the object can be swapped with one of a plurality of replicas of another object and not reduce a combined object; and swapping a replicas of the object with the one of the plurality of replicas of the other object only if the swapping does not reduce the combined object availability of the two object; working, in conjunction with one or more other processors of another computing device,

to determine whether a replica of a file managed by the computing device and a replica of another file managed by the other computing device can be swapped with one another to bring an availability of the file; wapping the replica of the file and the replica of the other file only if the swapping brings the availability of the file; an availability of the other file closer; and the availability of the other file closer; communicating with a first device on which the replica of the file is stored and a second device on which the replica of the other file is stored to have the first device transfer the replica of the file to the second device and delete the replica of the file on the first device, and to have the second device transfer the replica of the other file to the first device; a first plurality of computing devices storing files, a second plurality of computing devices managing storage of the files; wherein a first computing device of the second plurality of computing devices selects a file for which it manages storage and communicates with a second computing device of the second plurality of computing devices to determine whether a replica of the file and a replica of another file for which the second computing device manages storage can be swapped in order to improve a combined file availability; if the replicas can be swapped to improve the combined file availability, then instructing the one of the first plurality of computing devices on which the replica of the file is stored to transfer the replica of the file to the one of the first plurality of computing devices on which the replica of the other file is stored, and instructing the one of the first plurality of computing devices on which the replica of the other file is stored to transfer the replica of the other file to the one of the first plurality of computing devices on which the replica of the file is stored".

Examiner respectfully disagrees the entire allegation as argued. Examiner, in her previous office action, gave detail explanation of claimed limitation and pointed out exact locations in the cited prior art.

In response to applicant's argument on page 18, Duvillier does not teach the "homeless object". Duvillier teaches receiving a remove primary request, its swaps the primary and mirror assignments and other associated data structure information. The remove primary procedure may be evoked by a system modification request to cause a mirror data file to be reassigned as the new primary data and to remove the old primary data file from use in the persistent memory. The remove primary request is represented as an indication of mirror data file. As defined by the specification a particular file replica should be stored when the replica is not currently stored anywhere or its previous storage location is no longer available (page 14, lines 13-18). Similarly, the mirror data file is indicated to move to another location. It means that the storage location for the mirror data may be no longer available for the mirror data is represented as a homeless replica of an object (page 8, col. Right, lines 36-53).

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re*

Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, it would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data to Duvillier's system in order to reduce the network traffic that has to be generated to make a distribution decision, and reduces the complexity of such decision making.

Applicant argued that the combination of Duvillier and Zakai does not teach the claimed limitation "receiving an indication of a homeless replica of an object, wherein the object has a plurality of replicas including the homeless replicas; determining an initial placement for the homeless replicas, wherein the initial placement is one of a plurality of devices in a system; evaluating whether any replicas of the object can be swapped with one of a plurality of replicas of another object and not reduce a combined object; and swapping a replicas of the object with the one of the plurality of replicas of the other object only if the swapping does not reduce the combined object availability of the two object".

Duvillier teaches the claimed limitations:

"receiving an indication of a homeless replica of an object" as receiving a remove primary request, its swaps the primary and mirror assignments and other associated data structure information. The remove primary procedure may be evoked by a system modification request to cause a mirror data file to be reassigned as the new primary

data and to remove the old primary data file from use in the persistent memory. The remove primary request is represented as an indication of mirror data file. As defined by the specification a particular file replica should be stored when the replica is not currently stored anywhere or its previous storage location is no longer available (page 14, lines 13-18). Similarly, the mirror data file is indicated to move to another location. It means that the storage location for the mirror data may be no longer available for the mirror data is represented as a homeless replica of an object (page 8, col. Right, lines 36-53).

"wherein the object has a plurality of replicas including the homeless replica" as storing copies of selected disk pages located in memory (page 4, col. Right, lines 10-12);

"determining an initial placement for the homeless replica, wherein the initial placement is one of a plurality of devices in a system" as after the swap operation has been successfully completed, the old mirror data file will be assigned as the new primary data file, and the old primary data file will preferably be assigned as the new mirror data file. This information implies that the system has determined an initial placement is primary data file as a device in a system (fig. 4, col. Right, lines 36-53).

Duvillier does not explicitly teach the claimed limitation "evaluating whether any replicas of the object can be swapped with one of a plurality of replicas of another object and not reduce a combined object availability of the two objects and swapping a replica of the object with the one of the plurality of replicas of the other object only if the swapping does not reduce the combined object availability of the two objects".

Zakai teaches data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data (col. 6, lines 5-15). Thus, it would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data to Duvillier's system in order to reduce the network traffic that has to be generated to make a distribution decision, and reduces the complexity of such decision making.

Applicant argued that Zakai does not teach the claimed limitation " working, in conjunction with one or more other processors of another computing device, to determine whether a replica of a file managed by the computing device and a replica of another file managed by the other computing device can be swapped with one another to bring an availability of the file; wapping the replica of the file and the replica of the other file only if the swapping brings the availability of the file; an availability of the other file closer; and the availability of the other file closer".

Zakai teaches the claimed limitation

"working, in conjunction with one or more other processors of another computing device, to determine whether a replica of a file managed by the computing device and a replica of another file managed by the other computing device can be swapped with one another to bring an availability of the file" as data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. The above information indicates that when system determine availability of the data, the system already bring availability of other file closer (col. 6, lines 5-15);

"and swapping the replica of the file and the replica of the other file only if the swapping brings the availability of the file" as data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. The above information indicates that when system determine availability of the data, the system already bring availability of other file closer (col. 6, lines 5-15).

Zakai does not explicitly teach the claimed limitation "an availability of the other file closer; and the availability of the other file closer". Zakai teaches data availability

will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. The above information indicates that when system determine availability of the data, the system already bring availability of other file closer (col. 6, lines 5-15). Thus, it would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data in order to reduce the network traffic that has to be generated to make a distribution decision, and reduces the complexity of such decision making.

Applicant argued that Zakai does not "communicating with a first device on which the replica of the file is stored and a second device on which the replica of the other file is stored to have the first device transfer the replica of the file to the second device and delete the replica of the file on the first device, and to have the second device transfer the replica of the other file to the first device" as after selecting the data swap between storage volumes A and E, the service processor 28 searches for other data swaps between the remaining storage volumes B, C and D, F. Any further selections of data

swaps must further decrease the workload imbalance between the storage devices 15 and 16 by an above threshold amount. Swapping the storage volumes A and E makes the workload of the storage device 15 less than the workload of the storage device 16. Any other data swaps between the storage volumes B, C and the storage volumes D, F will increase the imbalance between the storage devices 15 and 16. Thus, the method 56 will only select to swap the storage volumes A and E for the workloads shown in FIG. 4A. FIGS. 6A-6C illustrate a time sequence for making the above-selected data swap between storage volumes A and E of the storage devices 15 and 16. To swap data, the pair of physical storage volumes A and E should have the same size and store data in the same emulation, e.g., fixed-block versus count-key-data. The swap uses a pair of buffer storage regions H and I, which are large enough to store the data from the storage volumes A and E, respectively (col. 6, lines 60-67; col. 7, lines 1-17).

Applicant argued that Zakai does not teach the limitation " a first plurality of computing devices storing files, a second plurality of computing devices managing storage of the files; wherein a first computing device of the second plurality of computing devices selects a file for which it manages storage and communicates with a second computing device of the second plurality of computing devices to determine whether a replica of the file and a replica of another file for which the second computing device manages storage can be swapped in order to improve a combined file availability; if the replicas can be swapped to improve the combined file availability, then instructing the one of the first plurality of computing devices on which the replica of the

file is stored to transfer the replica of the file to the one of the first plurality of computing devices on which the replica of the other file is stored, and instructing the one of the first plurality of computing devices on which the replica of the other file is stored to transfer the replica of the other file to the one of the first plurality of computing devices on which the replica of the file is stored".

Zakai teaches the claimed limitations:

" a first plurality of computing devices storing files" as host devices storing file (fig. 1A; col. 3, lines 3-25);

"a second plurality of computing devices managing storage of the files" as storage devices storing file (fig. 1A, col. 3, lines 3-15);

" wherein a first computing device of the second plurality of computing devices selects a file for which it manages storage and communicates with a second computing device of the second plurality of computing devices to determine whether a replica of the file and a replica of another file for which the second computing device manages storage can be swapped in order to improve a combined file availability" as data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data (col. 6, lines 5-15).

Zakai does not explicitly teach the claimed limitation

"if the replicas can be swapped to improve the combined file availability, then instructing the one of the first plurality of computing devices on which the replica of the file is stored to transfer the replica of the file to the one of the first plurality of computing devices on which the replica of the other file is stored, and instructing the one of the first plurality of computing devices on which the replica of the other file is stored to transfer the replica of the other file to the one of the first plurality of computing devices on which the replica of the file is stored".

However, Zakai teaches that data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. To implement priorities stored in file 50, the service processor searches for swaps of storage volumes A-G, in two stages, for each pair of storage devices 15-17. First the service processor searches for swaps of storage volumes A-G of a pair of devices 15 and 16. At step 59, the service processor 28 uses a search methodology to select data swaps that decrease workload imbalances by more than a threshold amount. The above information implies that system has included instructing to transfer data from one device to another device (col. 6, lines 5-55). Thus, it would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact

data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. To implement priorities stored in file 50, the service processor searches for swaps of storage volumes A-G, in two stages, for each pair of storage devices 15-17. First the service processor searches for swaps of storage volumes A-G of a pair of devices 15 and 16. At step 59, the service processor 28 uses a search methodology to select data swaps that decrease workload imbalances by more than a threshold amount in order to improve availability of a data without blocking access to data stored in storage devices.

In view of the above, the examiner contends that all limitations as recited in the claims have been addressed in this Action.

For the above reason, examiner believed that rejection of the last office action was proper.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-2, 4-7, 9-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Duvillier et al (or hereinafter "Duvillier") (US 2002/0073082) in view of Zakai et al (or hereinafter "Zakai") (US 6415372).

As to claim 1, Duvillier teaches the claimed limitations:

"receiving an indication of a homeless replica of an object" as receiving a remove primary request, its swaps the primary and mirror assignments and other associated data structure information. The remove primary procedure may be evoked by a system modification request to cause a mirror data file to be reassigned as the new primary data and to remove the old primary data file from use in the persistent memory. The remove primary request is represented as an indication of mirror data file. As defined by the specification a particular file replica should be stored when the replica is not currently stored anywhere or its previous storage location is no longer available (page 14, lines 13-18). Similarly, the mirror data file is indicated to move to another location. It means that the storage location for the mirror data may be no longer available for the mirror data is represented as a homeless replica of an object (page 8, col. Right, lines 36-53).

"wherein the object has a plurality of replicas including the homeless replica" as storing copies of selected disk pages located in memory (page 4, col. Right, lines 10-12);

"determining an initial placement for the homeless replica, wherein the initial placement is one of a plurality of devices in a system" as after the swap operation has been successfully completed, the old mirror data file will be assigned as the new primary data file, and the old primary data file will preferably be assigned as the new mirror data file. This information implies that the system has determined an initial placement is primary data file as a device in a system (fig. 4, col. Right, lines 36-53).

Duvillier does not explicitly teach the claimed limitation "evaluating whether any replicas of the object can be swapped with one of a plurality of replicas of another object and not reduce a combined object availability of the two objects and swapping a replica of the object with the one of the plurality of replicas of the other object only if the swapping does not reduce the combined object availability of the two objects". Zakai teaches data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data (col. 6, lines 5-15).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data to Duvillier's system in order to reduce the network traffic that has to be generated to make a distribution decision, and reduces the complexity of such decision making.

As to claim 2, Duvillier teaches the claimed limitation " wherein the replica of the object is stored on a first computing device, wherein the one of the plurality of replicas of the other object is stored on a second computing device, and wherein swapping the replicas comprises moving the replica of the object to the second computing device and moving the one of the plurality of replicas of the other object to the first computing device" as (fig. 4).

As to claim 4, Duvillier teaches the claimed limitation "wherein both the object and the other object have a same amount of replicas" as (fig. 4).

As to claim 5, Duvillier teaches the claimed limitation "wherein the object comprises a file" as (fig. 14, col. 8, lines 23-24).

As to claim 6, Duvillier teaches the claimed limitation "a plurality of files" as (page 3, col. Right, lines 56-59).

As to claim 7, Duvillier teaches the claimed limitation "a portion of a file" as (page 3, col. right, lines 56-59).

As to claim 9, Duvillier teaches the claimed limitation "randomly selecting the initial placement for the homeless replica" as (fig. 4, page. 8, col. Right, lines 42-52).

As to claim 10, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "determining, for each possible swapping of replicas of the objects, an object availability for each object; and checking whether any of the possible swapping result in a combined object availability of the two objects that is greater than the combined object availability prior to the evaluating" as (col. 6, lines 10-50).

As to claim 11, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teaches the claimed limitation "wherein combined object availability is not reduced if the availability of the object and the availability of the other object are no further from one another than they were prior to the evaluating" as (col. 6, lines 45-65).

As to claim 12, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "wherein the swapping results in increasing an availability of the object and decreasing an availability of the other object". (col. 6, lines 5-15).

As to claim 13, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "wherein the swapping results in decreasing an availability of the object and increasing an availability of the other object" as (col. 6, lines 5-15).

As to claim 14, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "selecting, prior to the evaluating, as the object one of a plurality of objects that the computing device is responsible for maintaining" as (col. 5, lines 50-60; col. 6, lines 5-15).

As to claim 15, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "randomly selecting one of the plurality of objects" as (col. 5, lines 50-60).

As to claim 16, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "selecting the one of the plurality of objects that has the lowest object availability" as (col. 5, lines 50-60).

As to claim 17, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "wherein the other object is one of a plurality of objects that a computing device is responsible for maintaining, and wherein the other object is randomly selected from the plurality of objects" as (col. 5, lines 50-65; col. 6, lines 5-15).

As to claim 18, Duvillier and Zakai disclose the claimed limitation subject matter in claim 1, Zakai further teach the claimed limitation "wherein the other object is one of a

plurality of objects that a computing device is responsible for maintaining, and wherein the other object is the one of the plurality of objects that has the highest object availability" as (col. 5, lines 50-65; col. 6, lines 5-15).

4. Claims 3 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Duvillier et al (or hereinafter "Duvillier") (US 2002/0073082) in view of Zakai et al (or hereinafter "Zakai") (US 6415372) and further in view of Mukherjee et al (or hereinafter "Mukherijee") (US 6466978).

As to claim 3, Duvillier discloses the claimed limitation subject matter in claim 1, except the claimed limitation "wherein the method is implemented by multiple computing devices in a serverless distributed file system". Mukherjee teaches serverless distributed file system (6, lines 45-50).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Mukherjee's teaching serverless distributed file system to Duvillier and Zakai in order to provides admission control and resource allocation and maintains the data integrity issues associated with the file.

As to claim 8, Duvillier discloses the claimed limitation subject matter in claim 1, except the claimed limitation "a directory". Mukherjee teaches serverless distributed file system (6, lines 45-50).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Mukherjee's teaching serverless distributed file system

to Duvillier and Zakai in order to provides admission control and resource allocation and maintains the data integrity issues associated with the file.

5. Claims 19, 22-33, 35-37 and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zakai et al (or hereinafter "Zakai") (US 6415372).

As to claim 19, Zakai teaches the claimed limitation

"working, in conjunction with one or more other processors of another computing device, to determine whether a replica of a file managed by the computing device and a replica of another file managed by the other computing device can be swapped with one another to bring an availability of the file" as (col. 6, lines 5-15);

"and swapping the replica of the file and the replica of the other file only if the swapping brings the availability of the file" as (col. 6, lines 5-15).

Zakai does not explicitly teach the claimed limitation "an availability of the other file closer; and the availability of the other file closer". Zakai teaches data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. The above information indicates that when system determine availability of the data, the system already bring availability of other file closer (col. 6, lines 5-15).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data to Duvillier's system in order to reduce the network traffic that has to be generated to make a distribution decision, and reduces the complexity of such decision making.

As to claim 22, Zakai teaches the claimed limitation "wherein the file represents a plurality of files" as (col. 4, lines 45-50; col. 10, lines 25-30).

As to claim 23, Zakai teaches the claimed limitation "wherein the file represents a portion of another file" as (col. 4, lines 45-50; col. 10, lines 25-30).

As to claim 24, Zakai teaches the claimed limitation "wherein the file represents a folder" as (col. 4, lines 10-15).

As to claim 25, Zakai teaches the claimed limitation "receiving an indication of a homeless replica of the file; and determining an initial placement, on one of a plurality of additional computing devices, for the homeless replica" as (col. 6, lines 6-15).

As to claim 26, Zakai teaches the claimed limitation wherein determining the initial placement comprises randomly selecting the initial placement for the homeless replica" as (col. 5, lines 50-60).

As to claim 27, Zakai discloses the claimed limitation subject matter in claim 20, except the claimed limitation "wherein the plurality of additional computing devices exclude any computing device on which a replica of the file is already stored" as (col. 3, lines 30-35).

A to claim 28, Zakai teaches the claimed limitation "wherein the file is selected randomly from a plurality of files managed by the computing device, and wherein the other file is selected randomly from another plurality of files managed by the other computing device" as (col. 5, lines 50-60).

As to claim 29, Zakai teaches the claimed limitation "wherein the file is selected as the one of a plurality of files managed by the computing device having a lowest file availability, and the other file is selected randomly from another plurality of files managed by the other computing device" as (col. 6, lines 5-15).

As to claim 30, Zakai teaches the claimed limitation "wherein the file is selected as the one of a plurality of files managed by the computing device having a lowest file

availability, and the other file is selected as the one of another plurality of files managed by the other computing device having a highest file availability" as (col. 5, lines 50-65; col. 6, lines 5-15).

As to claim 31, Zakai discloses the claimed limitation subject matter in claim 19, except the claimed limitation "wherein the computing devices is part of a directory group that is collectively responsible for managing a plurality of files including the file, and wherein the other computing device is part of another directory group that is collectively responsible for managing another plurality of files including the other file".

As to claim 32, Zakai teaches the claimed limitation "wherein the one or more processors of a computing device and the one or more other processors of another computing device are the same processors of the same computing device" as (col. 3, lines 50-65; col. 4, lines 1-25).

As to claim 33, Zakai teaches the claimed limitations:

" a first plurality of computing devices storing files" as host devices storing file (fig. 1A; col. 3, lines 3-25);

"a second plurality of computing devices managing storage of the files" as storage devices storing file (fig. 1A, col. 3, lines 3-15);

" wherein a first computing device of the second plurality of computing devices selects a file for which it manages storage and communicates with a second computing

device of the second plurality of computing devices to determine whether a replica of the file and a replica of another file for which the second computing device manages storage can be swapped in order to improve a combined file availability" as data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whether performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data (col. 6, lines 5-15).

Zakai does not explicitly teach the claimed limitation

"if the replicas can be swapped to improve the combined file availability, then instructing the one of the first plurality of computing devices on which the replica of the file is stored to transfer the replica of the file to the one of the first plurality of computing devices on which the replica of the other file is stored, and instructing the one of the first plurality of computing devices on which the replica of the other file is stored to transfer the replica of the other file to the one of the first plurality of computing devices on which the replica of the file is stored".

However, Zakai teaches that data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. To implement priorities stored in file 50, the service processor searches for swaps

of storage volumes A-G, in two stages, for each pair of storage devices 15-17. First the service processor searches for swaps of storage volumes A-G of a pair of devices 15 and 16. At step 59, the service processor 28 uses a search methodology to select data swaps that decrease workload imbalances by more than a threshold amount. The above information implies that system has included instructing to transfer data from one device to another device (col. 6, lines 5-55).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. To implement priorities stored in file 50, the service processor searches for swaps of storage volumes A-G, in two stages, for each pair of storage devices 15-17. First the service processor searches for swaps of storage volumes A-G of a pair of devices 15 and 16. At step 59, the service processor 28 uses a search methodology to select data swaps that decrease workload imbalances by more than a threshold amount in order to improve availability of a data without blocking access to data stored in storage devices.

As to claim 35, Zakai teaches the claimed limitation "wherein the second plurality of computing devices further receives an indication of a homeless replica of the file, and

randomly selects, as a computing device on which to store the homeless replica, one of the first plurality of computing devices on which no other replica of the file is already stored" as (col. 6, lines 50-60).

AS to claim 36, Zakai teaches the claimed limitations:

"initially place replicas of a file on different ones of a plurality of devices using a first process" as (col. 6, lines 45-50);

"and subsequently improve the placement of replicas of a plurality of files by evaluating whether any replicas of a first file can be swapped with any replicas of a second file without a reduction in the combined file availability of the first and second files" as (col. 6, lines 15-25).

Zakai does not explicitly teach the claimed limitation "swapping a replica of the first file with a replica of the second file if the swapping results in no reduction in the combined file availability of the first and second files". However, Zakai teaches that if swapping compromises data availability, the swap is not performed (col. 6, lines 10-15). This information indicates that the system just swaps data of devices if data availability without a reduction.

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of if swapping compromises data availability, the swap is not performed in order to improve availability of a data without blocking access to data stored in storage devices.

As to claim 37, Zakai teaches the claimed limitation "wherein the first process comprises random selection" as (col. 5, lines 60-65).

As to claim 39, Zakai teaches the claimed limitation "wherein the first file is selected randomly from a first plurality of files, and wherein the second file is selected randomly from a second plurality of files" as (col. 5, lines 60-65; col. 6, lines 45-60)

As to claim 40, Zakai teaches the claimed limitation "wherein the first file is selected as the one of a first plurality of files having a lowest file availability, and the second file is selected randomly from a second plurality of files" as (col. 7, lines 20-40).

As to claim 41, Zakai teaches the claimed limitation" wherein the first file is selected as the one of a first plurality of files managed having a lowest file availability, and the second file is selected as the one of a second plurality of files having a highest file availability" as (col. 7, lines 10-30; col. 6, lines 15-25).

6. Claims 20 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zakai in view of Rabinovich (US 6484204).

As to claim 20, Zakai teaches the claimed limitation "communicating with a first device on which the replica of the file is stored and a second device on which the replica of the other file is stored to have the first device transfer the replica of the file to the second device and delete the replica of the file on the first device, and to have the second

device transfer the replica of the other file to the first device" as after selecting the data swap between storage volumes A and E, the service processor 28 searches for other data swaps between the remaining storage volumes B, C and D, F. Any further selections of data swaps must further decrease the workload imbalance between the storage devices 15 and 16 by an above threshold amount. Swapping the storage volumes A and E makes the workload of the storage device 15 less than the workload of the storage device 16. Any other data swaps between the storage volumes B, C and the storage volumes D, F will increase the imbalance between the storage devices 15 and 16. Thus, the method 56 will only select to swap the storage volumes A and E for the workloads shown in FIG. 4A. FIGS. 6A-6C illustrate a time sequence for making the above-selected data swap between storage volumes A and E of the storage devices 15 and 16. To swap data, the pair of physical storage volumes A and E should have the same size and store data in the same emulation, e.g., fixed-block versus count-key-data. The swap uses a pair of buffer storage regions H and I, which are large enough to store the data from the storage volumes A and E, respectively (col. 6, lines 60-67; col. 7, lines 1-17). Zakai does not explicitly teach the claimed limitation "delete the replica of the other file on the second device". Rabinovich teaches delete a selected replica (abstract).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Rabinovich's teaching of deleting a selected replica to Zakai's system in order to maintain a replica in a storage system.

As to claim 38, Zakai teaches the claimed limitation " wherein swapping the replica of the first file with the replica of the second file comprises communicating with a first device on which the replica of the first file is stored and a second device on which the replica of the second file is stored to have the first device transfer the replica of the first file to the second device and delete the replica of the first file on the first device, and to have the second device transfer the replica of the second file to the first device" as (col. 6, lines 45-55). Zakai does not explicitly teach the claimed limitation "delete the replica of the second file on the second device". Rabinovich teaches delete a selected replica (abstract).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Rabinovich's teaching of deleting a selected replica to Zakai's system in order to maintain a replica in a storage system and to save memory space.

7. Claims 21 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zakai in view of Mukherjee.

As to claim 21, Zakai discloses the claimed limitation subject matter in claim 19, except the claimed limitation "wherein the one or more processors are part of a device in a server less distributed file system". Mukherjee teaches serverless distributed file system (6, lines 45-50).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Mukherjee's teaching serverless distributed file system

to Zakai's system in order to provides admission control and resource allocation and maintains the data integrity issues associated with the file.

As to claim 34, Zakai discloses the claimed limitation subject matter in claim 19, except the claimed limitation "wherein the second plurality of computing devices comprise one or more directory groups". Mukherjee teaches file system (col. 7, lines 34-35).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Mukherjee's teaching file system to Zakai's system in order to store data in hierarchy.

8. Claims 42-44 and 46-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Falls in view of Zakai.

As to claim 42, Falls teaches the claimed limitations:

"selecting another directory group to participate with in a replica placement improvement process" as (col. 3, lines 65-67 ; col. 4, lines 1-5);

"selecting a file maintained by the directory group" as (col. 3, lines 65-67; col. 4, lines 1-5).

Falls does not explicitly teach the claimed limitation "determining whether exchanging a replica of the file with a replica of another file maintained by the other directory group will increase a combined file availability of the files; having the replica of the file and the replica of the other file exchanged if exchanging the replicas will

increase the combined file availability of the files". Zakai teaches data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. To implement priorities stored in file 50, the service processor searches for swaps of storage volumes A-G, in two stages, for each pair of storage devices 15-17. First the service processor searches for swaps of storage volumes A-G of a pair of devices 15 and 16. At step 59, the service processor 28 uses a search methodology to select data swaps that decrease workload imbalances by more than a threshold amount (col. 6, lines 5-55).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Zakai's teaching of data availability will not be compromised by the swaps. The service processor 28 makes a check to determine whethe4r performing the swap will impact data availability. Availability is less affected if the storage subsystem 10 has multiple copies of the data to be swapped. If multiple copies exist, the swap of a storage volume A-G holding one copy does not reduce the overall availability of the data. To implement priorities stored in file 50, the service processor searches for swaps of storage volumes A-G, in two stages, for each pair of storage devices 15-17. First the service processor searches for swaps of storage volumes A-G of a pair of devices 15 and 16. At step 59, the service processor 28 uses a search methodology to select data swaps that decrease workload imbalances by more

than a threshold amount in order to improve availability of a data without blocking access to data stored in storage devices.

As to claim 43, Falls and Zakai disclose the claimed limitation subject matter in claim 42, except the claimed limitation Zakai further teaches "receiving, at the directory group, an indication of a homeless replica of the file; and selecting, as a computing device on which to store the homeless replica, one of a plurality of computing devices on which no other replica of the file is already stored" as (col. 4, lines 45-60).

As to claim 44, Falls teaches the claimed limitation "wherein the selecting comprises randomly selecting" as (col. 3, lines 65-67).

As to claim 46, Falls teaches the claimed limitation "wherein the file is selected randomly from a plurality of files managed by the directory group, and wherein the other file is selected randomly from another plurality of files managed by the other directory group" as (col. 3, lines 55-67).

As to claim 47, Falls and Zakai discloses the claimed limitation subject matter in claim 42, Zakai further teach the claimed limitation "wherein the file is selected as the one of a plurality of files managed by the directory group having a lowest file availability, and the other file is selected randomly from another plurality of files managed by the other directory group" (col. 6, lines 5-15).

As to claim 48, Falls and Zakai discloses the claimed limitation subject matter in claim 42, Zakai further teach the claimed limitation "wherein the file is selected as the one of a plurality of files managed by the directory group having a lowest file availability, and the other file is selected as the one of another plurality of files managed by the other directory group having a highest file availability" as (col. 6, lines 5-15).

9. Claim 45 is rejected under 35 U.S.C. 103(a) as being unpatentable over Falls in view of Zakai and further in view of Rabinovich.

As to claim 45, Falls and Zakai disclose the claimed limitation subject matter in claim 42, Zakai further teaches "wherein having the replica of the file and the replica of the other file exchanged comprises communicating with a first device on which the replica of the file is stored and a second device on which the replica of the other file is stored to have the first device transfer the replica of the file to the second device and delete the replica of the file on the first device, and to have the second device transfer the replica of the other file to the first device" as (col. 6, lines 45-55).

Falls and Zakai does not explicitly teach the claimed limitation "delete the replica of the other file on the second device". Rabinovich teaches delete a selected replica (abstract).

It would have been obvious to a person of an ordinary skill in the art at the time the invention was made to apply Rabinovich's teaching of deleting a selected replica to Fall's system and Zakai's system in order to maintain a replica in a storage system.

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cam Y T Truong whose telephone number is (571) 272-4042. The examiner can normally be reached on Monday to Firday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Breene can be reached on (571) 272-4107. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Cam Y T Truong
Examiner
Art Unit 2162
4/22/2005

SHAHID ALAM
PRIMARY EXAMINER